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Article

Dharmic Projects, Imperial Reservoirs, and New Temples of India: An Historical Perspective on Dams in India

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Abstract

As international attention continues to focus on large dam projects across Asia, it is worth noting that conflicts over the politics of and environmental changes caused by dams in India are not new. Population dislocation, siltation, disease, floods caused by catastrophic dam failure, raised water tables, high costs and low returns—all of these concerns, and others, can be discussed in the context of reservoir projects ten, one hundred, or even one thousand years old. In this paper, I identify some of the major issues in the political ecology of contemporary dam projects and show how these same issues have played out in southern India over the last thousand years, suggesting that historical attention to the cultural and political context of reservoir construction might help us to understand some aspects of contemporary conflicts.

Keywords: dams, development, South Asia, irrigation, siltation, temples, reservoirs, religion

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> Modern irrigation schemes in tropical areas are, almost without exception, social, ecological, and economic disasters. They necessarily lead to the flooding of vast areas of forest and agricultural land, the displacement of hundreds of thousands of people and the spreading of waterborne diseases like malaria and schistosomiasis. In addition, they are badly run, poorly maintained and the irrigated land is soon salinised or waterlogged, while the reservoirs where the water is stored, rapidly silt up. The remarkable traditional irrigation systems that they have replaced, on the other hand, not only worked perfectly, but also satisfied all social and ecological imperatives
> (Goldsmith 1998).

INTRODUCTION

Across the world, large dam projects have come under attack, castigated both for the large-scale environmental transformations they entail and the social dislocations that inevitably follow their construction. As products of modernist state planning, Indian dam 'projects', in particular, have come to stand for all the perceived evils of the modernist and statist world-view, a vision of governance and control over nature at odds both with more recent moves towards economic liberalisation and expansion of the private sector and with the various durable strands of anti-technologism and celebration of the small, the rural, and the traditional most clearly associated with Gandhian thinking. While there is little doubt that the state visions and structures—British and Indian—that brought India's twentieth and twenty first century reservoir projects into being shared agendas valourising centralisation, planning, imperial or national identification, technology, and progress, these views were (and are) rather more complex and, I would argue, more specific to the Indian context, than most accounts have allowed. When it comes to irrigation projects in South Asia, 'seeing like a state' (Scott 1999) has a long history and even older rural traditional projects, agricultural equivalents of Gandhi's beloved spinning wheel, do not escape the environmental and social problems that so plague modern dams. Further, many these older facilities were also products of what can only be called an entrepreneurial spirit, built with an eye towards personal gain, alliance, and power brokering that would not be out of place in a contemporary school of business or hall of parliament. As I show in this essay, a long-term historical view of dams and their reservoirs in India points to the ways in which the usual oppositions—socialism vs. capitalism, modern vs. traditional—used in contemporary

debates, on both sides, interdigitate rather than simply separate. Understanding this, I suggest, may help to move towards some resolutions to the dam debate and, in particular, to assess more realistically proposals to revive traditional irrigation as an alternative to building additional new dam projects.

In India, visible public protests against large dam and reservoir projects began in earnest only in the last few decades. Despite some successes, however, even very well-organised and highly visible social protests, notably the campaign opposed to the construction of the Sardar Sarovar project and others along the Narmada river in central India, have failed thus far to stop the construction of new dams and the planning of many more. Passions on both sides of the debate run high, a consequence of highly variable definitions of 'cost' and 'benefit,' socially located terms which defy quantification. Do the protesters have it right? Do the costs of reservoirs in India outweigh their benefits? If so, why have (democratically elected) Indian political leaders been so consistently enthusiastic about such projects? I address these questions against the backdrop of my long-term historical, archaeological, and paleo-environmental analysis of southern Indian reservoirs and irrigation systems, research that may shed some light on contemporary development debates as well as elucidate patterns of long-term change.

Although based on historical analysis, my target here is contemporary development rhetoric surrounding reservoirs1 irrigation, including positions both for and against large dam projects and smaller 'tank' projects. I consider why Indian political leaders continue to be enthusiastic about dams even in the face of significant domestic and international dissent, noting some culturally specific attitudes surrounding the patronage and maintenance of reservoirs in India that are sometimes overlooked in the development literature. While this history in no way accounts for the full complexity of the present debate, it certainly inflects the form such debate has taken.

I also examine the counter-claims of anti-dam groups who sometimes suggest, much as Goldsmith above, that the answer to sustainable and equable development lies in a return to a 'traditional' system of technology and management. While the critiques against large dams mounted by groups such as the International Rivers Institute's Patrick McCully (2001) are, in my view, largely justified, I would note that virtually all of the flaws of the larger, modernist projects can also be laid at the feet of traditional reservoir irrigation in southern India.2 Actual analysis of the long-term operation of pre-modern reservoir systems shows not only that older systems never worked perfectly, but also that they have *always* been power-laden technologies, intricately enmeshed in structures of inequality. Although many scholars have asserted that pre-modern irrigation systems in India were participatory in nature and thus apparently non-coercive3 repeating this truism does not make it true. All this is not to say that the impressive historic reservoir systems of South India and Sri Lanka have no contemporary value, nor to imply that older reservoirs will never repay rehabilitation. It is quite the opposite. Our work on the 3,000 year history of irrigation in southern India shows both success and failure in equal measure, portents for a reasonably hopeful future. Thus, although there is no simple solution to the water problems of the dry tropics of South Asia, surely an informed perspective on the actual historical experiences of the region must provide a more secure basis for future planning than either a romantic and unrealistic view of tradition or a blind faith in modern science and technology. Here I argue for a 'third way' in which both the historical complexity and the contemporary material existence of hundreds of thousands of older reservoirs, many silted in, breached, or otherwise damaged, is acknowledged. These facilities belong to the present as much as the past, and they constitute critical resources for rural South Asia. Their pasts can, indeed, help us plan their futures, just as their histories serve to bolster arguments made against large modern dams.

CRITIQUES OF LARGE DAMS

The development literature on dams and reservoirs is extensive and I make no attempt to review it all here. Briefly, however, it is possible to list some of the most common criticisms of dam projects (cf. McCully 2001). On the environmental side, problems include; the submergence of large areas of forest or arable land, sediment capture and siltation of reservoir beds which also leads to a loss of nutrient-bearing silt and to erosion below the dam, problems for migratory fish and other animals, micro-environmental effects on climate, possible tectonic effects, degradation of water quality caused, for example, by algae blooms, the loss of flood plain habitats, and changed near-shore ocean environments where dammed rivers meet the sea. Further, many critics also point to the dismal record of some existing large reservoirs, where water-logging and salinity have actually decreased crop yields. In virtually all cases, water is not equably distributed, and is diverted to water-intensive commercial crops such as sugarcane which 1) enriches already wealthy large farmers, 2) decreases food production, and 3) leads to reduced rural employment opportunities (Singh 1997). The rampant corruption documented in some recent projects has even resulted in actions which may seriously compromise public safety (Wade 1988).

On the human side, land submergence may mean the loss of land and property, such displacement having serious economic and psychological effects. Aside from these quite significant issues, many critics also contend that the costs of constructing and maintaining large reservoirs—not the environmental or human costs, which, while real, are difficult to quantify and rarely, if ever, figure in financial calculations—are simply not offset by the benefits gained in agricultural productivity, power generation, fisheries, or other products of the facility.4

On the whole, critics too are divided when it comes to what British colonial officials usually referred to as the protective function of irrigation works. Dams are sometimes represented as necessary both for flood control and (although this has not been a feature of the twentieth century) as protection against famine. At the same time, catastrophic dam breaches represent a serious threat to life and property, perhaps more serious

than the seasonal floods of untamed rivers. Abbasi (1991: 109) presents flood evidence from the Mahanadi river which suggests that flooding has actually been *more* common after the construction of the Hirakud dam than it was in the nineteenth century. However, my own work on the Tungabhadra river reveals the opposite pattern.

Defenders of large projects, needless to say, object to such critiques, pointing to the great need India has for power and irrigation, arguing that dams are a necessity for both food production and clean energy. The record of existing projects, including the much-discussed Bhakra-Nangal project, have been vigorously supported (e.g., Rangachari 2006).5 Given the powerful link between dams and nationalism, protest against planned or existing projects and even empirical challenges to the efficacy of large dams is easily cast by those in power as anti-national (see discussion by Klingensmith 2007). It is important to point out that many of the protest strategies adopted by anti-dam groups in India deploy techniques such as fasting and forms of non-violent direct action associated with the country's successful anti-colonial struggle. In this, protestors draw on a powerful set of symbols which directly index a Gandhian legacy and indict sitting officials morally as well as politically.

In the following sections, I address not so much the veracity of claims and counter-claims about modern projects, though my work includes consideration of the Tungabhadra project, a large twentieth century dam on the Tungabhadra river in Karnataka, as part of a study of pre-modern reservoirs in the same region. Rather, I am most interested in what an understanding of older reservoir systems may contribute to this debate, given both the large number of such features and their long histories. In order to use these histories, however, it is important to demolish the notion that pre-modern irrigation systems differed in fundamental or essential ways from modern ones. While important differences certainly exist and are discussed below, a more romantic perspective on the past, illustrated by Goldsmith above (and see Goldsmith & Hildyard 1984) tends to overdraw these differences, suggesting that traditional irrigation was: 1) more efficacious (less prone to fail, longer-lasting); 2) less environmentally intrusive; 3) associated with more egalitarian forms of resource access; and 4) more culturally appropriate. Let us first consider this 'new traditionalist' strand of thinking and then go on to an account of some actual histories of pre-modern reservoir systems in southern India.

New Traditionalists and Sustainable Development

This is not the place for a comprehensive review of environmental, anti-development, or alternative development movements in South Asia (see discussions by Baviskar 1995; Guha & Martinez-Alier 1997; Singh 1997; Guha 2000; D'Souza 2008) and it is not my intention to gloss over the important differences between groups in terms of their goals, assumptions, and positioning. Instead, I merely wish to examine one strain of nostalgia that colours some arguments about the potential alternatives to large dams, an argument that while perhaps on the fringe, tends to erase the rich material record we possess of past facility performance by relegating older features to a kind of golden age.6 The challenges I pose here to the belief in locally-managed, perfectly-functioning, and environmentally-neutral traditional irrigation systems are not meant to weaken the basic critique of mega-dams; on the contrary, they should strengthen it by showing some of the long-term continuities in both the environmental and human problems associated with the manipulation of land and water.

In what Sinha *et al.* (1998) refer to as a 'new traditionalist' discourse, the Indian rural past is imagined to have been a time when local communities managed their own resources in an equitable and sustainable way. Linked to the critique of large colonial and post-colonial statist projects, then, is a simple inversion whereby the proposed solution to the human and environmental problems of the present are located in old, small, pre-colonial, locally-based facilities (or at least in new ones that mimic this structure). Coming at the problem from the opposite end, that is, as an archaeologist studying the long-term histories of agriculture and irrigation in southern India, I find these assumptions remarkable especially insofar as they posit a mode of life that I have simply been unable to reconstruct even as my work has expanded to incorporate three thousand years of agrarian history. As I discuss below, 'golden age' thinking is a cultural tradition shared by both South Asians and Europeans and it is perhaps not too surprising that narratives of present-day decay and decline should continue as part of international development discourse. At the same time, however, such discourse also constitutes a real danger insofar as it posits an (impossible) return to an imaginary past as a solution for the real needs of rural people. Recognition of the complex interplay of power relations and environmental process in the past—in which, for example, soil erosion and elite consumption have been closely linked in empirical analyses (Morrison 2009)—need not create despair about the present. Perhaps we can no longer retreat to the comforting vision of a more equable and efficient past, but surely the recognition of unsuspected continuity between past and present does provide us with a greater range of models for assessing the possible implications of our current actions.

A BRIEF HISTORY OF RESERVOIRS IN SOUTH INDIA

Middle Period Reservoirs: Birth of the Traditional System

Although I consider debates over contemporary dam construction across all of modern India, it is certainly the case that 'traditional' reservoirs are unevenly distributed across the subcontinent. Those in southern and central India and Sri Lanka are the best-studied, perhaps because these are also the regions where they are most numerous. On a northbound flight from Bangalore, for example, a tip of the wing on a sunny day reveals hundreds of sparkling reservoirs thickly spread across the rural landscape. The vast majority of these were constructed in the Middle periods and although they are thus

'pre-modern', they are also still in use and are critical 'modern' features as well. It is not necessary to assume that the problems with traditional reservoirs in the dry parts of southern India are representative of those from the entire nation in order to see striking parallels between the problems of these past facilities identified through archaeological analysis and the problems with modern projects noted by dam critics. The fact that both old and new facilities share some common environmental and social effects suggests that these effects are very real.

The earliest reservoirs in South Asia date to the Iron Age (ca. 1000-500 BCE), with excavated examples from northern Karnataka (Bauer & Morrison 2007). The technology expanded during the Early Historic (500 BCE-CE 500) when extensive systems of canals, dams, and weirs appeared in both Sri Lanka (Myrdal-Runebjer 1996) and central India (Shaw 2007). None of the very early reservoirs we documented in Karnataka were used beyond the Early Historic period and none are still in use. Similarly, the 'tanks' documented by Shaw now lie abandoned as archaeological features rather than parts of a living landscape. This pattern would soon change.

Following the Early Historic, reservoirs played an important role in the Early Medieval (CE 500-1300) or Early Middle period, as numerous textual sources make clear, and they continued to be important through the Late Middle period (CE 1300-1600). Although small dam-and-basin facilities for water impoundment continued to be built and used, Middle period reservoirs (Morrison 1993, 2009) typically consist of masonry-faced earthen dams thrown up across valleys, at the base of hills, and in other locations where seasonal runoff and small streams could be captured. Some reservoirs were supplied via canals, which took off via diversion weirs or *anicuts*, from perennial rivers. Water was moved downstream through masonry-lined tunnels built under the embankment or bund; some water was also released over specially-constructed waste weirs, facilities which range from boulder-filled cuts to elaborately-built spillways. Although the focus is clearly on the storage and downstream distribution of water, reservoir beds were also sometimes used for cultivation and reservoirs served as important sources of fish, silt and clay, and water for livestock. As I discuss below, Middle period reservoirs were patronised by a wide range of political leaders from kings (rarely) to local chiefs (commonly) and were connected with Hindu temples in a number of ways (Morrison & Lycett 1994, 1997; Morrison 1995, 2009).

Reservoirs were particularly important in the far south, present-day Tamil Nadu, and in northern Sri Lanka where many were supplied by river-fed canals (Brohier 1934; Ludden 1999). In these areas we see the greatest elaboration of the so-called 'system reservoirs', long chains of facilities that flow one into the other, linking large areas into tightly-knit watersheds. In more arid regions, reservoirs were often more widely spaced and the more reliable canal-fed facilities were rare, but where demand for produce and water was high, the level of investment in irrigation technology could be high indeed (Morrison 2009).

It should be noted that Middle period reservoirs, 'traditional'

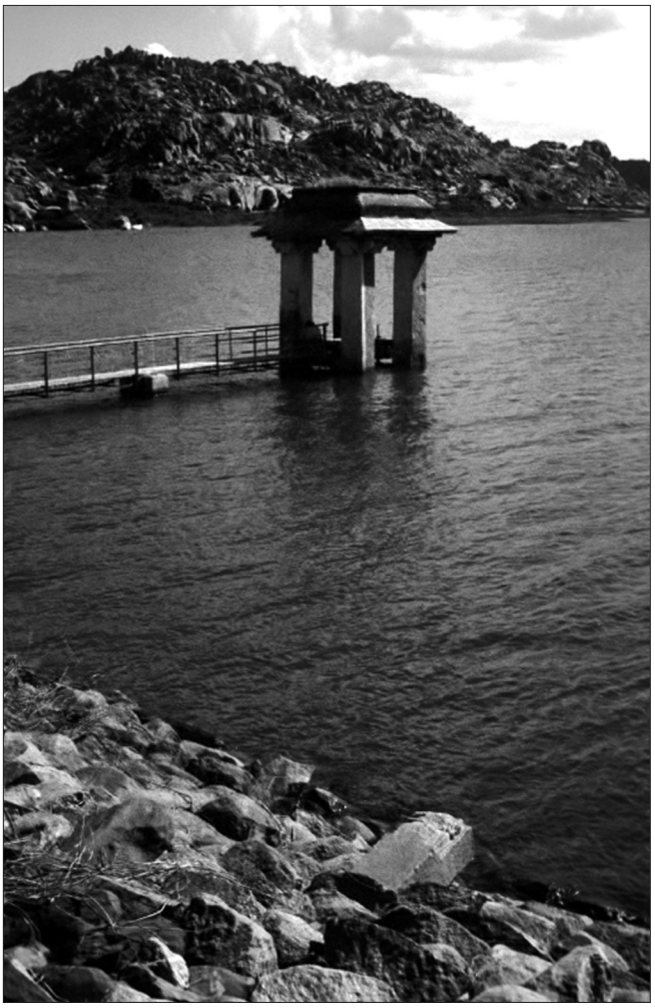

Figure 1

The Daroji reservoir was originally built in the sixteenth century and has been continuously maintained and used ever since. Falling within the specifications of a 'large dam', its embankment is more than three km long and its elaborate stone sluice gates follow architectural forms used in contemporary Hindu temples. This reservoir dams a seasonal river and is now partly fed by a canal from the Tungabhadra dam

by any reckoning, ranged widely in size (Figure 1) from very small ponds to vast 'seas', the latter falling well within the contemporary definition of a large dam.7 Thus, the notion that large projects are a solely modern obsession is decidedly incorrect. Further, the argument sometimes advanced that all very large reservoirs were built by kings bent on self-aggrandisement (e.g., Leach 1968) while smaller ones were built by cultivators themselves for actual use, does not stand up to historical scrutiny. On the contrary, both small and large reservoirs were deeply political, tied to networks of patronage and power; small reservoirs did not belong to a privileged sphere of wise peasants living close to nature. Analysis of texts (Morrison & Lycett 1997) describing the patronage of irrigation facilities shows no systematic relationship between facility size and rank of patron. In fact, in Karnataka kings were rarely involved with reservoirs; this despite the accounts of some Portuguese merchants who assumed that royal patronage was behind some of the large projects they observed. Secondly, the

Figure 2

The Avinamodugu reservoir was also built in the sixteenth century, but was abandoned in less than fifty years after filling in with silt and breaching several times. This double sluice gate is almost completely buried under approximately three m of silt. Cracked soil near the sluice shows that the dam still retains some water seasonally

actual use-lives of reservoirs show that small facilities failed at least as often as large ones; there is no reason to see larger reservoirs as systematically less successful than smaller ones.

This pattern of extensive reservoir use in the far south of the peninsula (the Tamil country) contrasts with that of drier regions in the northern interior of the peninsula (Karnataka and parts of Andhra Pradesh). In these drier regions, reservoirs were (and are) almost exclusively runoff-fed and, given lower rainfall, they are generally not as closely spaced as those of the southern Tamil country. Still, many regions saw the use of both chains of linked system reservoirs and isolated reservoirs. Indeed, it would have been difficult for south Indian agriculture, diet, and cuisine to have taken the forms they did without reservoir irrigation (Morrison 2001). In the area I have studied in northern Karnataka, reservoirs seem to have been only a minor component of Early Middle period agricultural strategies (Morrison 2009), but by the Late Middle period (CE 1300-1700), and especially with the expansion of the large but loosely-knit empire of Vijayanagara across much of the peninsula, reservoir irrigation expanded considerably, especially in the drier zones where it had previously been limited. In my study area, in and around the eponymous capital city of this empire, urban foundations in the early 1300s and the subsequent expansion of settlement and explosion in population in the region propelled reservoirs into increasingly important component of larger agrarian and political strategies. Important from the start of the Vijayanagara period, reservoirs also constituted a key form of agricultural intensification in the sixteenth century or Late Vijayanagara period, especially in regions where canal irrigation was not feasible. Reservoirs played variable roles in the processes of Vijayanagara agricultural intensification and collapse, variation structured by political factors and settlement dynamics as much as runoff and soil. What is common to most parts of the urban hinterland, however, is the way in which the vast majority of reservoirs fell out of use after (in some cases, during) the Vijayanagara period. Very few of the reservoirs from the original system still effectively function though there are a few notable 'living' reservoirs with long histories of maintenance and reconstruction (Morrison 1993, 1995) and local farmers often use abandoned reservoirs in limited but important ways, for example growing crops in the bed of the facility or harvesting water from one small functioning corner of a once-vast artificial lake.

The research reported here draws on analyses of pollen and charcoal from reservoir sediments (allowing reconstruction of fire and vegetation histories), sedimentological studies of reservoir fill, including estimations of bed siltation, stylistic analyses of sluice and embankment construction, landscape studies of changes to local hydrology and erosional regimes, and historical analyses of the tens of thousands of contemporary records describing facility construction and maintenance as well as conflicts over water, land, labour, and rule. All of these diverse lines of evidence suggest that Middle period reservoirs, like their contemporary and colonial counterparts (Mosse 2003: 45–46), were highly unreliable sources of irrigation. Runoff-fed reservoirs, in particular, may fail to fill in dry years. In the drier districts, this meant that not only could reservoirs not support wet crops such as rice, but even that in rainfall-deficit years, dry crops might not be assisted by the facility. The situation was somewhat better in areas of higher rainfall, but everywhere in southern India reservoirs are marked by high evaporation rates, high siltation rates, and ongoing maintenance challenges. Arrangements for maintenance required supra-household coordination and were often met in the Middle period through specific grants of land or cash made by political leaders. When political structures broke down, however, so did these arrangements. Thus, the transformed landscape created by thousands of reservoirs can be read as a political history as much as an ecological one.

Understanding the organisation of irrigation works, including reservoirs, has long been an area of interest for historians and archaeologists. During the Vijayanagara period, no Wittfogel-like centralisation of irrigation control can be documented, though the critical role of landed elites in the construction and maintenance of all irrigation facilities is quite clear (Ludden 1979; Stein 1980; Morrison 1995). Furthermore, reservoir construction clearly operated as both a political and economic investment for donors (Breckenridge 1985; Morrison 1995, 2009), a form of private power and revenue enhancement that stood alongside any public benefits of enhanced irrigation. Reservoirs could even be bought and sold, as evidenced by inscriptions from such transactions (Morrison 2009).

Although space does not permit a point-by-point comparison of the problems of modern and Middle period dams, I would mention that both the ecological and social costs of the latter were significant. Construction projects required massive mobilisations of labour (Morrison 1995), not all of which was voluntary. Shah's recent (2008) work on oral histories from the same region as my archaeological analysis dramatically illustrates the historical memory of grievance suffered by specialist Vodda 'tank diggers' (who also appear in contemporaneous inscriptions). Far from a 'collective,

communal project of construction some recent scholars assume,' (Shah 2008: 663), their recent descendants note that Vodda construction workers were often not paid, paid inadequately, or otherwise coerced or tricked into providing labour for elite-led reservoir projects. In areas of considerable water insecurity and uncertainty, including Shah's and my study area in northern Karnataka, almost every reservoir is also associated with an account of sacrifices made to prevent reservoir breaching or allay drought (problems of too much water too fast, or too little), sacrifices whose costs were disproportionately borne by women, and occasionally low-caste men (Shah 2008: 670–671). What is at stake here is not so much the literal truth of contemporary folk tales, which do however conform impressively well to historical and archaeological understandings, but to the persistence of subaltern perspectives which contradict the rosy view of the new traditionalists and which provide a resource for the construction of a third way between existing polarised perspectives.

Chains of reservoirs and reservoirs blocking small rivers created major changes in hydrology and sediment flow, changing habitat distributions for plants and animals. Deforestation of watersheds and failure to maintain watershed terraces were serious problems (Morrison 1995), problems evident both during eras of high population and times of political unrest and population loss. Siltation was, as a consequence, a serious problem (Figure 2), leading to the abandonment of hundreds of reservoirs. Middle period reservoirs also regularly experienced catastrophic dam failure, breaches that must have caused significant damage to humans and animals. Every reservoir I have studied has been patched and rebuilt many times; in some cases dam breaches (usually associated with bed siltation and overtopping) were the final cause of abandonment. In some cases, dam failure was so catastrophic that serious archaeological effort was required to reconstruct reservoir morphology, while in other cases, moderately damaged facilities continue to provide reduced services to local farmers and herders.

The standing water of India's traditional 'tanks' provided ideal habitats for invasive New World weeds such as the water hyacinth as well as for water-borne diseases and their vectors. Singh (1997: 150) notes that Raichur district, Karnataka, on the north bank of the Tungabhadra river, became highly endemic to malaria after the establishment of the Tungabhadra dam and its canals in the mid-twentieth century. What he does not mention is that Bellary district, on the southern bank, and the locus of a very extensive Vijayanagara-era (Middle period) canal and reservoir network, was *already* an endemic area for malaria. Many fewer Middle period reservoirs and canals were located on the Raichur side of the river; thus, this area experienced an increase in parasite problems only with the construction of the Tungabhadra project. Neither district should have malaria, however, given the very dry environment and lack of natural standing water.

On a human scale, displacement was also a problem. As has been frequently noted, in some places in southern India, reservoirs are so thick on the ground that it is difficult to imagine constructing new ones. In my own historical dissection of the history of one valley system, it is clear that the sixteenth century construction of some new, relatively large reservoirs in a place that previously had fewer, more widely-spaced facilities meant the submergence of land once used for other purposes, and even the displacement of some villages. By reconstructing the historical development of settlement, agriculture, and irrigation in the Daroji valley, I was able to show not only how catastrophic dam failure led to shifts in village and field locations, but also how the construction of newer reservoirs in the sixteenth century led to significant loss of land attached to earlier facilities and even to the inundation of roads and temples (Morrison 2009). Although the stories of rulers and other elites as patrons and power brokers can be discerned from the textual record, the less-visible tragedies of displacement can be read only from the evidence of archaeology and oral history.8

In general, larger facilities with deeper water and more reliable sources of water (i.e., without marked dry seasons) are more difficult to maintain, their very strength—abundant flowing water—also being one of their greatest weaknesses. Of course, such facilities also cost more to build and require greater initial engineering expertise; here contemporary critiques of large dams are indeed germane. One should also note, however, that some of the longest-lasting reservoirs, for example, one built in the fourteenth century and still in active use, are not only the largest but also the ones with the most reliable water supplies—canals from perennial rivers or large seasonal streams/small rivers. So in these cases, the greater risks of these large facilities seem to have been offset, in the minds of local peoples and political leaders over the centuries, by their greater water capacities. Importantly, paleoecological data as well as historical documents suggest that the more perennial forms of irrigation—river-fed canals and canal-fed reservoirs in particular—were dedicated to the production of commercial, cash crops as early as the fourteenth century. In this semi-arid region, rice, sugarcane, fruit, flowers, and a variety of water-intensive crops were grown under canals and some reservoirs at the same time that the mass of population scraped out a living from rainfed millets and pulses (Morrison 1995, 2001). Water distribution was far from equable, benefiting those with political clout whose access to land and water allowed them to engage in commercial production.

It may seem that reservoirs, especially runoff-fed reservoirs, are hardly worth the cost and trouble of building and maintaining, and in some cases, I think this is correct. However, there is a huge amount of variation in the level of facility success which mitigates against easy generalisation. Significantly, my specific study was centred in a very dry area where irrigation is especially risky. Even here, however, local sentiment for the last nine hundred years or so has run strongly in favour of reservoirs. There are many good reasons for this, not least because reservoir-irrigated lands allow somewhat less risky dry farming and, in exceptional cases here (and more commonly elsewhere), reservoirs sometimes allow the production of culturally valourised wet crops such

as rice (Morrison 2001). As noted, reservoirs also serve other functions such as repositories for silt, clay, wild plants, and fish, sources of groundwater recharge for wells, and even as transportation nodes and defensive works. Because the funding for new reservoirs was almost always put up by political leaders, for whom such patronage was both a religious duty and political strategy (below), initial costs were small from farmers' perspectives. Such patronage, further, linked local people to larger worlds of warriors, gods, and kings, connections even now cherished and preserved in local lore.

Colonial Reservoirs

After the fall of the city of Vijayanagara in 1565, reservoir abandonment accelerated rapidly and by the beginning of the seventeenth century most of the very extensive network of runoff-fed facilities in the study area was abandoned. No new reservoirs were built in this region between the late sixteenth and mid-twentieth century although there was clearly a sustained effort to maintain a few large and well-watered (notably, those fed by river water and by larger seasonal streams) reservoirs. Elsewhere, reservoirs continued to be built and used although construction histories, tied as they were to local political contexts, varied widely from place to place. Patterns of patronage continued to follow older models which stressed the importance of gift-giving (including reservoir patronage) and largesse as signs of legitimate rule (see Price 1996; Mosse 2003). The cessation of both construction and most maintenance activities in my study region can thus be laid at the feet of political uncertainly and flux rather than a decisive environmental failure of the system, though as noted breaching and reduced capacity were constant problems.

Like Middle period reservoirs, Early Modern reservoirs were also deeply implicated in unequal social and political relations, a far cry from the egalitarian world imagined by some advocates of sustainable development. Describing the eighteenth century system of wetland produce shares (contrast Gadgil & Guha 1992) in southern Tamil Nadu, Mosse (2003: 80) notes, 'The points to stress are, first, that through the order and form of its shares the system articulated a representation of village level relations of caste and power, and reproduced unequal (caste-based) access to common property. Second, it legitimised the social hierarchy as a royally instituted division of labour. Finally, it brought the interests of the state (or its fragments) deep into villages, linking local irrigation systems to a transactional system that extended beyond the village to temples and the palace. As such, this was simply a continuation of a pattern well-established in the preceding centuries'.

After the fall of Tipu Sultan at Srirangapattanam in 1799, parts of my study area fell into what came to be called the Ceded Districts, districts ceded by the Nizam of Hyderabad to the British. The British imposed what was called a *ryotwari* settlement in this area, meaning that individual cultivators paid taxes directly to the colonial government and what the British saw as the commons, including many irrigation facilities (though many deeded to religious institutions continued to be privately held), were claimed by the state. Elsewhere in the south, where the *zamindari* settlement, which created a class of intermediate landholders or *zamindars*, was imposed, many reservoirs were assigned to *zamindars* who thus also assumed the obligation to maintain them (see Mosse 2003).

In the *ryotwari* areas where the British had a parallel obligation to maintain irrigation works, analysis of Public Works Department (PWD) documents reveals interesting patterns of selective investment. Larger facilities, certainly, were favoured, but both large and small reservoirs could earn the label *imperial tank*, a designation that had less to do with production than with destruction. The breaching of reservoirs can lead to loss of life, soil erosion, village destruction, and can also threaten critical transport routes. Imperial tanks, regularly repaired by the irrigation department, were so designated not because of their productive capacity or local importance, but because their breaching could affect the railway.9 Thus, the destructive power of reservoirs could become objects of state concern, a pattern which pre-dates the colonial period. Interestingly, British writing around irrigation often deployed a rhetoric of protection—dam projects seen as providing protection against floods, poverty, and especially famine. Specific works were classified as productive, protective, or both. Indeed, one government official (Krishnswami 1947: 103, see below) complained that protective works were being unreasonably expected to generate revenue. The category of protective works continued unchanged into the post-independence era. Indeed, the twentieth century Tungabhadra project is an uneasy hybrid of hydroelectric dam and a project intended to provide 'protection' to subsistence farming through the supplemental watering of dry crops, a policy honoured primarily in the breach and which has engendered significant conflicts over water distribution (Mollinga 2003).

I have suggested that in some contexts, Middle period reservoirs represented dubious investments; although they constituted a critical form of irrigation, they were also costly and risky to a degree that raises the question of why they were so popular. I discuss this at length elsewhere (Morrison 2009) but, as explained briefly below, it seems that the specific cultural logics of southern India helped to extend this critical but problematic irrigation form even into environments where it gave marginal economic returns. The tone of much current literature on the colonial period might suggest that the colonialism brought in a completely new (rational, scientific) way of conceptualising the value of irrigation, a change often seen as the root of the current problem. However, if a case can be made that a clear-cut, profit-loss logic was not always paramount in the Middle period, it also seems clear that the *cultural* value of irrigation sometimes trumped its income value, even in the Colonial period. This is evident in the rhetoric of protection but it also comes out, for example, in budget projections which reveal internal differences between PWD officials and higher-ups who sanctioned new projects. For British irrigation engineers, like their more recent counterparts, reservoirs represented a self-evident good (as well as a living) ; PWD bureaucrats may not have been above

supplying over-optimistic figures on project returns in order to advance their beliefs and careers. In an official account of rural Madras Presidency, Krishnaswami (1947: 102–103) complains that expectations of returns to (new) projects have been greatly overestimated, but not because of the difficulty of obtaining accurate estimates:

> It would be more reasonable to infer that it is a result of a legitimate fear that if the true position is carefully estimated from the beginning, a project would never be sanctioned. Consequently, the original estimates are attempts to bloat up the income figures in order to pay homage to a principle [revenue] which, if meticulously followed, would result in practically no useful irrigation work being sanctioned.

Krishnaswami (1947: 102) goes on to detail the returns on nine projects (all reservoirs) begun between 1919 and 1934 in which the expected return on capital ranged from 2.6% to 8%. Actual returns ranged from 0.16% to 4.52%, with six of the nine projects returning less than 1%. Like Middle period reservoirs then, colonial reservoirs, while independently valued for their important contributions to rural life and governance, were not highly remunerative, a record that should certainly give advocates of new projects pause.

Independent India and Large Dam Schemes

Many of the large dam projects of independent India were either planned or partially built during the colonial period, and many projects have complex political histories. Although I will not discuss the more recent history of dam-building in India, this country has been notably enthusiastic about such projects. Ambitious irrigation projects were an integral part of Soviet-style national economic planning in the early years after independence, especially insofar as they would generate electricity for industry and help keep food prices low for urban and industrial workers (Singh 1997: 59–60; Kulke & Rothermund 2004). Ward (2003: 1, 2002) calls India 'one of the most active dam-building countries on earth.' As is also well-known, the last 20 years have also generated some of the most intense and well-organised anti-dam movements in the world, including the *Narmada Bachao Andolan* (Save the Narmada Movement), and many others.

In the case of the Tungabhadra project, planned since the mid-nineteenth century but completed only in 1954 (Indian independence took place in 1947), justifications for the project changed significantly from being solely a protective work (against famine) to also generating hydropower. During its long and chequered planning history dating back over 100 years (Krishnaswami 1947: 90), the project was marked by the kinds of political disagreements (Royal Commission on Agriculture 1927) that also plagued would-be patrons during the Middle period. Government units involved in the project included, at different times, the British-ruled Madras Presidency, the princely state of Hyderabad, and the post-independence states of Mysore and later Karnataka. The filling of the Tungabhadra dam flooded at least 40 villages and perhaps hundreds of smaller reservoirs and temples. Official figures of the number of persons displaced—just over 65,000—are displayed, rather curiously, on a sign at the public viewing area on the dam itself, amid a list of facts and figures about the facility. The Tungabhadra dam has experienced severe siltation in its fifty-plus year history and now faces some serious challenges, including, by some estimates, waterlogging and salinisation of more than 33% of its command area (Singh 1977: 147; cf. Mollinga 2003).

Although many reservoirs, even ones first built as long as a thousand years ago, continue to be used and to be important, in my study area privately-held bore wells with electric pumps are gradually moving into areas formerly dominated by reservoir irrigation. Bore well irrigation is facilitated by the electricity made available by projects such as the large Tungabhadra dam and by government incentives. The availability of deep wells has also modified the relationships between nucleated settlements and reservoirs. While once all rural villages in this region were located next to a reservoir, now towns and villages can survive some distance from their reservoirs as most have wells within the settlement and residents need not rely on reservoir water for drinking and cooking. In spite of these changes, reservoirs remain important for stock watering, washing clothes, silt collection, brick making, and gathering plants and aquatic products, even where they provide minimal benefit to agriculture. In this region where there are very few twentieth century reservoirs, virtually of the extant facilities are Middle period facilities, most in very poor repair. With the state unable or unwilling to maintain them, these ancient reservoirs are becoming smaller and less visible on the landscape each year.

I hope this selective historical tour of 'traditional' reservoirs as well as one 'modern' reservoir has made clear the dubious logic that draws an uncrossable line between these two categories. Such thinking tends to associate the modern with ecological risk, failure, and danger, as well as state power, oppression of the poor, and an irrational enthusiasm for size and for western science (more on this below), while viewing traditional systems as sustainable, equitable, and environmentally sensitive, perhaps more valuable as ideas than as physical features, a distinction that would certainly seem illogical to the contemporary farmers for whom older reservoirs are part of a living productive landscape. Terminological issues are partly at fault here, with few recognising that Indian 'tanks' are also in fact dams—some falling in the official category of 'large dams' —with associated reservoirs. Not only did traditional systems radically transform the landscapes [soils, hydrology, flora, and fauna (see Morrison 1995)] of the Middle period when they were first constructed, but they have always been connected to political patronage, unequal power relations, poverty, and displacement (Shah 2008). At best, then, the nostalgia of the new traditionalists seems a bit misplaced. What is worse, however, is that both ahistorical perspectives on past irrigation and idealized views of contemporary small-scale irrigation (Mosse 2003) weaken a potentially powerful weapon in the fight against large dams. There are so many older dams, with long use-lives and histories, that it would be

possible to place the debate on a much more secure empirical footing by including them in our assessments of success and failure, and while there is still much to do along these lines, our current understanding of the long-term dynamics of these older facilities lends credibility to many of the critique of large dams.

CULTURAL LOGICS OF RESERVOIRS IN INDIA

Given that reservoirs of all ages, sizes, and types share some common problems, it does seem to be the case that the sharp distinction between (evil) modern dams and (good) traditional ones cannot be justified. What engineers call embankment dams and gravity dams are still being constructed, along with newer forms of technology, though heavy machinery has replaced human feet in compacting the critical impermeable clay core. What has changed in the facilities themselves, quite apart from social, environmental, and economic contexts, is the scale of the watercourse selected for control, with attempts to contain perennial rivers more typical of recent reservoirs. Certainly issues of scale do matter, but as we have seen, smallness assures neither functionality nor equality. Equally, many 'traditional' systems were very large indeed, with environmental impacts comparable to some contemporary schemes, particularly since large reservoirs rarely existed in isolation but were almost always parts of linked systems including other reservoirs, check-dams, terraces, wells, and other features (Morrison 2009). Thus, the modern/pre-modern dichotomy that animates such discourse seems overdrawn, not least because so many 'pre-modern' features are still with us.

But if reservoirs in southern India have always been somewhat less than perfect, how can we account for the enthusiasm of South Asian political leaders from around the tenth century onward for their construction? Obviously, there is no single answer to this question, but I would like to suggest that there are some longstanding connections between reservoirs in particular, and notions of legitimate rule, Hindu religious beliefs, and religious institutions such as temples that are rarely discussed in the context of modern conflicts over dams in India. On the contrary, dam detractors tend to assume that Indian leaders from Nehru onward have been in thrall to western science and technology, having lost their connections with 'traditional India'. Clearly, if there is no actual *qualitative* divide between the massive dam projects of today and the extremely large projects of the past, then the equation between modernity and monumentalism already appears weakened. I mean to extend this suggestion, however, noting that at least some of the mania for dam-building in India today seems explicable not so much as a break with tradition but as a continuation of it. In order to demonstrate this, let us pass quickly over the major time periods discussed above, this time considering the ideology and rhetoric of reservoirs rather than their actual operation.

The Middle Periods in the South

In Middle period South India, one animating principle of rule was the importance of gift-giving, widely discussed in the historical literature (e.g., Stein 1980; Shulman 1985; Dirks 1987; Heitzman 1997). Gifts of land, money, produce rights, and valuables were made to, most often, religious institutions such as temples, monasteries, and Brahman villages. In many cases, these gifts were much more than simple alienations, and can be thought of as investments that paid material, spiritual, and political returns. It is in fact not too extreme to see prestation as one of the primary acts of governance, such that a gift also implied a claim of power and rival gifts a threat to one's authority. In this milieu, endowing irrigation works held a special salience both as source of religious merit and as an index of legitimate rule (Morrison 2009). Among the many lists of the seven most auspicious things a person can do in his (and these are clearly for men) lifetime, building a reservoir is always one. In Andhra, the notion of the 'sevenfold progeny' (Wagoner 1993; Talbot 2001), the seven most enduring legacies one can create, enumerates the construction of a reservoir alongside such acts as the endowment of a temple and the birth of a son. Unlike some other forms of patronage (building a canal, for example, or performing the royal horse-sacrifice), reservoirs could be relatively modest investments, available to middle-level political leaders, a fact that was particularly important in the complex and multi-layered political forms of the day. In fact, in the Vijayanagara period, (Morrison & Lycett 1994), reservoirs were most commonly endowed by *nayakas*, elite leaders with a primarily local power base. To be patron of a reservoir, then, was a potentially realisable goal for local elites, one that was accompanied by special religious merit as well as political prestige.

The physical forms of many Middle period reservoirs linked them quite clearly with temples and with the divine. Sluice gates of Vijayanagara-era reservoirs, for example mimicked the forms of temples, especially temple doorways, with elaborate mouldings and even carvings of deities. Some sluices even had elaborate brick and plaster superstructures creating small *vimana* or temple towers atop the sluice gate. Other kinds of sacred, watery iconography associated with reservoirs included lotuses, *makara* (mythical crocodile-like creatures), elephants, and snakes (Morrison 2009). Reservoirs were thus clearly meant to evoke and to be temples, monuments, and sacred places as much as productive facilities.

Finally, I mention just two other aspects of the cultural logic of reservoirs in the Middle period. First was the pervasive sense of a present state of decline relative to a past golden age, a notion with considerable scriptural backing. This manifested itself in texts that represent new acts of construction as simply putting things right and restoring former glories, a pattern which Michell (1994) has commented on in the context of the relative lack of foundation inscriptions on temples. This is less true for reservoirs where we do have many foundational records, but it is possible to detect this nostalgic strain quite clearly across several textual genres.

The second feature worth noting is the way in which reservoirs and other water-holding features were conventionally celebrated for their beauty. Green plants, especially the startling bright green of young paddy, water flowers such as lotuses,

birds, and women in the fields with their brightly coloured saris all constituted literary tropes of a well-run and prosperous realm. Reservoirs were thus visually important, often meant to look impressive as well as to expand and improve agriculture. This aesthetic is also quite clearly indexed to symbols of political power and virility (Morrison 2009).

Many texts emphasise the location of royal capitals and sacred places alongside perennial rivers; reservoirs tend also to be portrayed as full of water and hence beautiful, able to support flowers, crops, birds, etc. In a rare mention of reservoir seasonality (note that it is the time right after the rainy season described and not the dry season), a Kannada text attributed to Mangarasa (*Samyukta Koumudi*, ca. CE 1509) notes 'With the setting in of the autumn season, the rainy days were over, the water reservoirs were full of water everywhere, the fields appeared attractive with the standing ripe crops of paddy of different kinds and with the young ladies seen in the fields engaged in driving away the birds, particularly the parrots, the milking cattle were yielding good amount of milk and there appeared everywhere promising prosperity...' (Kotraiah 1995: 7). The association of attractive (and labouring) young women, and of parrots with paddy fields achieves the status of a cliché in contemporary literature. Paddy, women, and green parrots all being brightly-coloured objects (in this gendered, elite-situated perception) of value and beauty, all of whom, it is worth noting, owe their presence in this view to the actions of strong and moral men who rule, build reservoirs, and maintain order.

COLONIAL LOGICS: REVENUE, RULE AND PROTECTION

Under the British, the rhetoric surrounding the support of reservoirs changed to some extent, consonant with British understandings of good governance and of common property. Agricultural productivity was more transparently and directly linked with government revenue, although clearly this had always been a concern. In some places indigenous rulers continued to have significant rights and responsibilities with regard to reservoirs and here we can see some continuity in the logic of prestation that also underlay Middle period politics (Dirks 1987; Mosse 2003). If British officials and engineers did not tend to extol the beauty of the green fields or count up the religious merit they were accruing, however, there is a sense in which the rhetoric of protection (above) echoed indigenous notions of the duties of rulers toward their subjects. That is, under colonial rule, provision of irrigation continued to constitute a visible sign of legitimate rule, just as it had for their predecessors. In the earliest days of the Company Raj, British officials even made grants to temples and in general conformed to at least some local expectations of governance. Of course, 'protection' not only meant the protection of subjects from floods and famine, but also protection of the British against the potential unrest such calamities might entail. I have already mentioned the designation of some reservoirs as imperial tanks where they impinged on strategic resources such as the railways; as always, then, reservoirs were part of contested political realms. Finally, we can also observe in the Colonial period the continued trope of a past golden age of irrigation, a state the British saw themselves as restoring (thus entering into a very long history of self-representation in which the traditional order, having fallen apart for one reason or another, is restored by the righteous ruler). In his study of colonial and contemporary reservoir irrigation in Tamil Nadu, Mosse (2003: 11) notes both the power-laden, political nature of resource management as well as the impossibility of locating the systems so clearly envisioned by the new traditionalists:

> In the following chapters, images of autonomous villages and stable resource management will give way to stories of vulnerable systems dependent on unreliable investments by warrior overlords; the history of community will give way to a history of statecraft. The impact of colonial governance on water commons defies simple representation, but has more to do with the changing systems of state than the erosion of village tradition. Indeed, traditional water management systems prove extremely elusive, and identification of the moment of their collapse is an impossible task involving a seemingly endless journey back in time.

Like scholarly and popular representations of Indian 'tribals' (Morrison 2002), in which traditional lifestyles are consistently represented as having only just disappeared, no matter whether the observer was situated 100, 10 or one year ago, students of Indian agricultural history seem consistently to assume that the period(s) they study constituted the time when traditional arrangements for local self-governance were finally and fully destroyed, having been fully in place just prior to the period(s) in question.

AFTER INDEPENDENCE: THE NEW TEMPLES OF INDIA?

The post-independence history of India has not always represented a radical break with the colonial past, a fact certainly true for irrigation planning. As early as 1938, the National Planning Committee (NPC), a committee composed of four merchants and industrialists, five scientists, three economists, and three politicians began working on what would be the seed of independent India's first five-year plan (Singh 1997: 59). The three politicians, critically, included a labour leader, a Gandhian, and Jawaharlal Nehru, who would become India's first prime minister and who served in this capacity until his death in 1964. At least one strand of post-1947 political leadership under the Congress Party—led by Nehru—explicitly espoused an embrace of western science and technology, what Visvanathan (1998: 43) calls 'statist science', a bureaucratised form stressing technology transfer rather than integration of Indian and western knowledge forms. Nehru's clear pro-science stance has led virtually all commentators to see Nehru's famous comment on the opening of the Bhakra project in 1954 as a straightforward embrace of modernity (cited in Singh 1997: 55):

> "When I walked around the site, I thought that these days, the biggest temple and mosque and gurdwara is the place where man works for the good of mankind. What place can be greater than Bhakra Nangal, where thousands of men have worked or shed their blood and sweat and laid down their lives as well? Where can be holier than this; which can we regard as higher?"

Nehru is also reputed to have whispered to himself, "These are the new temples of India where I worship" (Gopal 1984; and see D'Souza 2008). While the interpretation of Nehru as modernist is undoubtedly correct in the main, I would suggest that there is also a little-noticed cultural inflection to these comments . That is, reservoirs in India already had a more than 600-year history of both evoking and being temples, an association backed up by considerable scriptural sanction. Nehru knew his history. In making these comments, he was perhaps not simply parroting an imported western attitude. Instead, he was also expressing what we might call a good South Asian point of view about the sanctity of these little oceans. One large sixteenth century reservoir in my study area is named 'ocean of *dharma*;' many more also have names evoking the sacred. As noted, pre-colonial attitudes towards irrigation were not completely eradicated by colonialism and, even in light of Nehru's professed desire to 'catch up' with the west, I would suggest that his actions and attitudes fit well into the well-developed mould of Indian political history. Like other Indian rulers before him, he was striving to be 'a righteous king, wealthy, happy, and desirous of acquiring fame,' in the language of the Anantarajasagar reservoir inscription of CE 1369 (Randhawa 1980: 99).10 To note the political power of irrigation in the construction of rule, even within modern India, is not of course to make any judgement about the relative benevolence of leaders from any particular time or place, nor to discount the considerable sums of money at stake, financial benefits that once accrued to the donors of irrigation works in Middle period India and which no doubt still motivate some proponents of large dam projects.

Beyond politics and finance, the Middle period aesthetic favouring reservoirs, with their flowers and greenery, also finds an echo in the literature of contemporary tourism. Just as Middle period literary works exulted in the delights gardens and ponds provided to elites—hunting, admiring flowers, boating, etc.—modern dams are often tourist attractions providing multiple options for the visitor, albeit on a more democratic model. Connections with state power are also not lost. *The Hindu*, for example, recently (Monday August 16, 2004, electronic edition) reported, under a headline, "Tungabhadra Dam almost full":

> Every year on Independence Day (except for the past three years [due to drought]), the crest gates would be opened. Hundreds of people from various parts of the district visited the dam to witness the spectacular sight. They also visited the garden, dancing fountain, deer park and the aquarium.

At the designated viewing area itself, imagery such as a giant map of India unambiguously proclaims the national significance of the dam. Published tourist guides also extol its beauty and all government tours of the great abandoned city of Vijayanagara (Hampi), a UNESCO World Heritage site, end with a sunset visit to the Tungabhadra dam. In a rather different form of tourism, the government of Gujarat has recently decided to charge tourists for a view of one of the contested dams under construction on the Narmada river. The cost of a peek will be Rs. 5 a person, but parking will reportedly cost between 10 and 100 Rupees (Indo-Asian News Service, July 18, 2005).

DISCUSSION: WHAT CAN WE LEARN FROM ANALYSIS OF PRE-MODERN RESERVOIRS?

Analysis of the actual life-histories of South Indian irrigation systems indicates that there never was a golden age of Indian irrigation marked by environmental stability, egalitarian social relations, and complete community self-governance. Middle period reservoirs dramatically reshaped the landscapes in which they were built, changing not only hydrology and sedimentary and erosional regimes, but also animal habitats and vegetation distributions. As noted, changes in disease distribution are also associated with irrigation, even ancient irrigation. The problems of reservoirs are many, and these are not exclusive to reservoirs built in the last two centuries, to reservoirs with concrete dams, or to large reservoirs.

Some problems are, however, clearly linked to scale and to the nature of the water source. Completely damming a large, perennial river clearly requires a very large dam, but a perennial water supply also means that it will be quite difficult, if not impossible to clear silt from the facility. As noted, silt was often seen as one of the beneficial products of a reservoir, as well as being a constant maintenance concern.11 The water depths of many modern facilities make silt removal virtually impossible. Further, reservoirs which dry up seasonally may have much reduced waterlogging and parasite incubation potentials. At the same time, such reservoirs also do not provide as much water for agriculture and it is instructive that, following the collapse of the Vijayanagara agrarian system in the late sixteenth century, virtually all of the runoff-fed reservoirs were abandoned while canals and canal-fed reservoirs continued to be used and maintained.

Beyond their significant environmental effects, traditional reservoirs ('tanks') were always politically and religiously-charged features. The very earliest reservoirs in India are consistently associated with megaliths, signalling their (at least partly) ritual functions. The history of Middle period reservoirs, the 'classic' period when the 'traditional' system took on its basic form, is one of elite patronage and public largesse, of power relations inscribed on the landscape as well as in stone inscriptions on temples and boulders. Land, labour, and water were not evenly distributed and there existed significant inequities linked to the changed productive potential of the land. In some areas, rice, sugarcane, vegetables, and

tree crops were grown year-round, while in others a single crop of millets and legumes was scratched from the sandy soil.12 Temples were deeply involved in agrarian regimes, even to the extent that reservoirs of the Vijayanagara period took on the forms and iconography of temples. In some cases, villages, fields, and religious structures were inundated as new facilities were built. For example, the sixteenth century Daroji reservoir flooded a large area formerly under cultivation, as well as earlier settlements and shrines.

These political entanglements live on in local memory, encoded in the names of reservoirs as well as oral history. As Mosse (2003: 55) notes of his fieldwork on modern reservoir systems in Tamil Nadu:

> ...our conversations about tanks and water flows turned to the actions of kings and warrior leaders. Questions of water rights and disputes over them pointed to matters of royal gift and temple honours and the arbitration of warrior heroes. Indeed, understood in terms of kingly acts of giving, royally instituted grants and privileges, this landscape of tanks and channels is a representation of order and authority in rural society.

Specifically South Asian cultural logics of reservoirs, while certainly never unitary and never fixed, still seem to echo into the present, even in discourses about development in which religion is never explicitly raised. Common to all periods, and even among the 'new traditionalists' is the trope of decline and decay, a belief, or perhaps a feeling, that has a long heritage both inside and outside South Asia. Bound up in ideas about legitimate rule, meritorious behaviour, and the protection of subject peoples, contemporary thinking about irrigation in India derives from indigenous traditions as well as imported knowledge systems. Reservoirs, even without the specific architectural and textual allusions to temples, gods, and both mythical and real water creatures (Morrison 2009) that appear on Vijayanagara facilities, still evoke the divine through such devices as names that link them with, for example, the eternal ocean from which the earth emerged and within which it is still encircled. This cultural history inflects Nehru's famous statements about dams as temples, mosques and gurdwaras; while he was no doubt an advocate of western-style science and progress, the easy fit between his Bhakra project comments and the attitudes of a generation of leaders before him suggests that his debt to modernity was slightly less pronounced than has usually been acknowledged.

Let me conclude, then, with a few thoughts on the future. While empirical work has shown that 'golden age' arguments about the efficacy and appropriateness of traditional irrigation systems are unfounded, and it is clear that all kinds of reservoir systems experience significant problems, this does not mean that irrigation should be abandoned. The very real needs for food and livelihood of one billion people mean that efforts must be made to sustain agricultural production. A return to the past is neither possible nor perhaps desirable; where effective and equable systems of water distribution exist today (e.g., the *damasi* system, Padre 2005: 10) they are not necessarily remnants of ancient practice. Such strategies can be emulated without the need for a pseudo-history, though the persistence of the trope of restoration rather than invention suggests that such projections are politically astute if not historically warranted.

At the same time, the landscape of reservoirs, many lying broken and (at least partially) abandoned, is now a geographic fact for much of southern India and Sri Lanka. The environmental damage has, to a certain extent, already been done. Efforts of NGOs and other organisations to mend and rejuvenate older reservoirs have been quite successful and, as long as the need for constant maintenance is recognised and expectations of return are realistic, such programmes have considerable potential. State involvement in irrigation projects as well as their politicisation is not necessarily a symptom of post-coloniality but a constant feature of Indian history. Labour exploitation, land inundation, and unequal resource distribution, too, have a deep antiquity. Age does not make these features desirable, just as tank restoration will not necessarily be followed by rural harmony. It is not necessary to falsely valourise the past in order to critique large development projects. Indeed, recognition of the shared effects of reservoirs—old, new, traditional, modern, large, small—on the natural and human environment can only strengthen and sharpen contemporary debate.

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Notes

1. 'Reservoir' here refers to the water contained behind an artificial embankment (dams or *bunds*) as well as the dam itself. Reservoirs are built across paths of gravity water flow, whether streams, rivers, or simply slopes that might carry runoff after a rainfall. These features may or may not involve excavation of a basin, but are all storage or storage/distribution devices built on a relatively large scale and meant to contain water *behind* (an embankment or dam) rather than *within* its major construction and for this water to come from gravity flow rather than water tables. In this, I differentiate between cisterns (which collect and store water within a rock-cut or other constructed facility), wells (which

tap the water table), reservoirs, and tanks. The term tank is widespread in the South Asian literature, indiscriminately used to describe almost any water-holding feature, although the term most frequently refers either to reservoirs or to temple tanks, the latter being large masonry structures, often stepped, that hold water for ritual ablutions and other functions associated with temple worship. Temple tanks often derive their water from the water table (wells), although they may have other sources of supply. As such, temple tanks and reservoirs are wholly different in construction, morphology, and operation, similar only in their capacity as water holding devices and in certain parallels of meaning and symbol. I thus reserve the term tank to mean something more like temple tank, and employ the term reservoir only for water-retaining embankments, a usage consistent with the meaning of the term elsewhere in the world. Note, however, that the term 'tank' is commonly used in India to refer to reservoirs.

2. Some of the confusion might derive from terminology. South Asian 'tanks' are just as much reservoirs as are modern dams. Thus separating small dams from tanks actually makes little sense (e.g., Singh 1997: 217–27).

3. Perhaps the most influential proponents of a strict pre-modern/modern divide have been Gadgil and Guha (1992), whose review of environmental history in India asserted that precolonial caste differentiation could be seen as analogous to ecological niche differentiation, an argument which naturalises power disparities to an amazing degree. In another context, (Morrison *in prep*), I develop an extensive critique of this work and the larger tradition of dividing past and present along a colonial axis in the context of the creation of a new kind of socio-natural history, but demolition of the pre-modern/modern divide—with specific reference to reservoirs in southern India—is most effectively made by Shah (2008) who, critically, comes to many of the same conclusions as I have based not on the archaeological evidence, but on oral histories. As she also notes (2008: 654), the notion that 'tank irrigation fell from its pre-modern grace as a result of the intervention of colonial rule' (a key component of the Gadgil and Guha account of history) is not justified and thus 'The imagined history of tanks used in development policy is not based on rigorous scholarly analysis.'

4. One of the few cost-benefit analyses of dam construction, based on comparative data from across India, is that of Duflo and Pande (2007). Importantly, they find the balance to be generally unfavourable, even without any consideration of the environmental 'costs' of such projects. That is, large dams fail even in their own terms, without consideration of environmental impacts. Singh (1990), also conducted a cost-benefit analysis of dams, this time, including a calculation of environmental costs, to come to a similar conclusion. Detailed analyses can also be found in Rangachari *et al.* (2000) and World Commission on Dams (2000).

5. Rangachari's (2006) defence of the Bhakra project is, of course, far from the only work evaluating this iconic dam. Dharmadhikary (2005) provides a compelling alternative analysis, based on a detailed three-year study. My aim here is not to provide a complete bibliography of pro- and anti-dam research, but to point out the acrimony of the debate and the existence of highly polarised positions, even among those who claim to be providing disinterested scientific analysis.

6. As Mosse (2003: 9) notes, 'It would be absurd to suggest that an identifiable traditionalist discourse characterizes all of Indian environmental thinking... Moreover, revivalist thinking, focusing on ancient collectivities or a Hindu organic social order, find support from groups that are intellectually and ideologically distinct for example, secular environmentalists and Hindu nationalists.'

7. According the World Commission on dams (2000: 8), a 'large dam' is one 15 or more meters high. By this definition, several Middle period dams in my study area qualify as 'large' even before the additional criterion that dams between 5 and 15 meters high but containing a volume of more than 3 million cubic meters is added, an added criterion that brings several more of these older facilities into the category of 'large dams'.

8. 'Once upon a time, Dannayakan Mudda, the king of the Vijayanagara kingdom, went around his domain to find out about the welfare of his people. When he passed by a village of Haragnur he felt that it was a beautiful place, suitable for the construction of a tank. After twelve years of worship, the Mudda convinced the deity of the local temple—Anjaneyyaswamy—to help him build a tank. The god modified the Mudda's plan, which would have displaced twelve upstream villages and twelve downstream villages, to shift only three villages upstream and three downstream. The people from these villages formed a new village which was then called Haragnur'(Shah 2008: 652)..

   The story then goes on to recount how the king tricked the Vodda workers who built the tank into working without payment, a punishment he argues was the god's doing.

9. From five imperial tanks in the Madras Presidency in 1884-85, the number rose to 87 in 1898-99 (Annual Progress Report of the Irrigation Branch of the Public Works Department in the Madras Presidency for the Year 1885-85: 1885; Annual Progress Report of the Irrigation Branch of the Public Works Department in the Madras Presidency for the Year 1898-99: 1899, and interim reports).

10. This inscription describes the construction of reservoir damming the Maldev river in present-day Andhra Pradesh. With a dam 1,372 m long and 10 m high, this facility is only of middling size. The inscription details the number of labourers involved in the construction of the facility and prescribes desirable and undesirable qualities for reservoirs in general. These qualities include not only attributes of the landscape, water supply, and arable soils, but also political considerations, including concern for the location of political boundaries, the availability of skilled workers, and, of course, the presence of a patron, the aforementioned 'righteous king.'

11. Here it is important to note the critical role of watershed maintenance. In the Daroji valley of Karnataka, where the failure rate of sixteenth century reservoirs was nothing short of catastrophic (Morrison 2009), with high rates of siltation and dam breaching, pollen and sediment analysis shows that watersheds had been denuded of woody vegetation and that erosion was severe. Regional contexts, and not only the immediate technology of the reservoir, play a crucial role in success or failure.

12. Despite its classification as a protective work, meant to provide supplemental watering to dry crops (so-called 'irrigated dry') such as millets, pulses, and oilseeds, water from the Tungabhadra project is, in fact, monopolised by head-enders to grow water-intensive commercial crops such as rice, sugarcane, and bananas (cf. Mollinga 2003). Middle period canals clearly also watered exclusive areas of commercial wet crops, a distribution plan which favoured a select few, just as now.

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